Paleontological Impacts Technical Memorandum

I-25 Improvements Through the Colorado Springs Urbanized Area Project

CDOT Project No. IM 0252-316

Project Control No. 12210

Colorado Department of Transportation

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1.0 Project Description

1.1 Proposed Action

The Proposed Action would widen Interstate 25 (I-25) from South Academy Boulevard (Exit 135) to State Highway 105 (Exit 161, Monument), a distance of approximately 26 miles. Within these limits, a six-lane cross-section (three through-lanes in each direction) would be built south of the U.S. Highway 24 Bypass to South Academy and north of Briargate to SH 105. Additionally, for the 12-mile central portion from the US 24 Bypass (Exit 139) to Briargate Parkway (Exit 151), the Proposed Action consists of an eight-lane cross section (four through-lanes in each direction).

In the eight-lane cross-section, the inside (left-most) lane in each direction would be open to general traffic during off-peak hours; during morning and evening peak hours, this lane would be reserved for use by carpools and buses only. To accommodate this flexible use, the high-occupancy-vehicle (HOV) lane would not be barrier-separated from the general-purpose lanes, but would be demarcated by appropriate signage and striping.

The non-barrier HOV treatment also allows for decommissioning of the lanes back to general-purpose operation in the event that the lanes do not result in adequate peak-period usage to justify HOV operations. This will depend in part upon public willingness to fund expanded transit operations that would use the HOV lanes. The HOV lanes are projected to be marginally successful without transit system expansion, but could become solidly successful if used by buses on hypothetical future routes (currently unfunded). Express bus service between Colorado Springs and Monument began in 2002 as a 3-year "demonstration project."

In conjunction with the additional laneage, the Proposed Action includes interchange reconstruction at several locations. These include major reconstruction of existing interchanges at:

- Exit 141 – Cimarron (U.S. Highway 24)
- Exit 142 – Bijou Street
- Exit 145 – Fillmore
- Exit 147/148 – North Nevada Avenue and Rockrimmon Boulevard (consolidated)
- Exit 156 – North Gate Road, plus freeway-to-freeway ramps for Powers Boulevard
- Exit 158 – Baptist Road

For each of the interchange reconstruction projects, numerous design alternatives were considered and evaluated. These alternatives were presented for review and input at advertised public meetings.

Additionally, minor geometric changes will be made at Exit 146, Garden of the Gods Road. The existing southbound-only ramps at Exit 147 A (Corporate Centre Drive) will be closed, with access via a local street connection to the reconfigured Nevada/Rockrimmon interchange. In conjunction with freeway widening on U.S. Air Force Academy property, the Ackerman Overlook will be relocated to a safer location.

1.2 Paleontology Overview

Paleontologic field surveys of Interstate 25 (I-25) between Widefield and Monument (mileposts 131.8 and 161.4) were conducted on August 24th, 25th, and September 27th, 2002. The southern end of the corridor (MP 131.8) lies in the NE¼ NE¼ SW¼ SW¼ of Section 24, T. 15 S., R. 64 W. The northern end (MP 161.4) lies at a point in the N½ SE¼ SW¼ SW¼ of Section 11, T. 11 S., R. 67 W. Each field survey consisted of an inspection of the corridor for 1) surface fossils, 2) exposures of potentially fossiliferous rocks, and 3) areas in which fossiliferous rocks or younger potentially fossiliferous surficial deposits could be exposed or otherwise impacted during construction. Prior to the field survey, literature and museum record searches were conducted in order to aid in the assessment of the paleontologic sensitivity of the survey corridor and the geologic units present within.

The survey corridor contains eight mapped geologic units. Surficial deposits include artificial fill, eolian sand, colluvium, terrace alluvium and pediment gravel, and all of these units have low paleontologic potential. Bedrock geologic units include the Pierre Shale, Laramie Formation, and Dawson Formation, from oldest to youngest (Carroll and Crawford, 2000; Scott and Wobus, 1973; Thorson et al., 2001, Thorson and Madole, 2002). The Pierre Shale is well known for its abundant fossil invertebrate fauna, as well as less common but scientifically important vertebrate fossils, and is considered to have moderate paleontologic potential. The Laramie Formation contains plant fossils and more vertebrate fossils, and has moderate paleontologic potential. The Dawson formation contains locally abundant plant fossils and less common vertebrate fossils, and has moderate paleontologic potential. The latter formation and related units, as well as the fossils they contain, are the subject of active research by scientists at the Denver Museum of Nature and Science (DMNS), and are thus particularly important.

The DMNS has four previously documented fossil localities within the survey corridor, and two more which are very close to it. Two additional localities were documented during the field survey (1 plant, 1 invertebrate). Because of the paleontologic sensitivity of these units, continuous or spot check monitoring of all areas where they will be impacted by construction excavations is recommended. When the project design plans are finalized, the CDOT staff paleontologist should examine them in order to estimate the impact to these formations, and the scope of paleontological monitoring work, if any, which is required (see Table 2 and recommendations for details).

2.0 Existing Conditions – Geology and Paleontology

The survey corridor contains eight mapped geologic units. Surficial deposits include artificial fill, eolian sand, colluvium, terrace alluvium and pediment gravel, and all of these units have low paleontologic potential. Bedrock geologic units include the Pierre Shale, Laramie Formation, and Dawson Formation, from oldest to youngest (Carroll and Crawford, 2000; Scott and Wobus, 1973; Thorson et al., 2001, and Thorson and Madole, 2002).

The late Cretaceous (Campanian and Maestrichtian) Pierre Shale is marine in origin, and is about 4,500 feet thick in the vicinity of the survey corridor. Lithologies of the Pierre include hard, platy to flaky gray, dark gray, brownish-gray, grayish-black, tan shales and silty shales, light olive gray silty bentonitic shales, limestones, and ironstone concretions (Carroll and Crawford, 2000; Haymes, 1989; Gill and Cobban, 1966; Scott and Wobus, 1973; Thorson et al., 2001; Thorson and Madole, 2002; Wood et al., 1957). The invertebrate and vertebrate fossil faunas of the Pierre Shale in Colorado, Wyoming, South Dakota, Montana, Kansas, and New Mexico have been the subject of far more studies than can be cited here (Bergstresser, 1981; Bishop, 1985; Carpenter, 1996; Cobban et al., 1993; Gill and Cobban, 1966; Kauffman and Kesling, 1960; Lammons, 1969; Martz et al., 1999; Scott and Cobban, 1986; and many others). The invertebrate fauna includes a diverse assemblage of mollusks (primarily ammonites and inoceramids), as well as other bivalves, bryozoans, and gastropods. The ichnofauna consists primarily of trails, burrows, tubes, fecal pellets, and raspings on shells (Gill and Cobban, 1966). The vertebrate fauna is also diverse, containing a variety of fish, turtles, mosasaurs, plesiosaurs, and more rare dinosaurs, pterosaurs, and birds (Carpenter, 1996). Because the Pierre Shale contains abundant invertebrate fossils, and less common but scientifically important vertebrate fossils, it is considered to have moderate paleontologic potential (Type 2 of Raup, 1987; Class 3 of PFYC).

The late Cretaceous (Maestrichtian) Laramie Formation is divided into three informal members (Thorson et al., 2001). The lower member consists of light gray to light brownish-gray very fine grained sandstone interbedded with gray sandy shale and minor brown organic-rich shale, as well as sub-bituminous coal. It is approximately 115 feet thick. The middle sandstone member consists of thick to very thick-bedded, light colored, cross-bedded fine to coarse sandstones interbedded with thin-bedded gray and brown shale. It is about 200 feet thick. The upper member consists of brownish-gray sandy shale and very fine-grained shaly sandstone, thin coal beds, and channel fillings of fine- to medium-grained light colored sandstone. It is about 400 feet thick. The Laramie Formation is interpreted as a complex of channel, overbank, deltaic, and swamp deposits which were deposited shortly after, and in association with, the retreat of the Western Interior Cretaceous Sea (Weimer and Land, 1975). The Laramie contains invertebrate, plant and vertebrate fossils. Significant vertebrate fossils are far less common than plants and invertebrates, although a relatively rich concentration of microvertebrates from Weld County, Colorado, was described by Carpenter (1979). These fossils are housed at the University of Colorado Museum. Because it contains locally abundant plant fossils but only few vertebrate fossils, it is considered to have moderate paleontologic potential (Type 2 of Raup, 1987; Class 3 of PFYC).

The Dawson Formation in this area includes rocks of both late Cretaceous (Maestrichtian) and early Paleocene age, and consists of light gray to tan arkose and thin, interbedded gray claystone. It weathers to brown, reddish-brown, and orange-brown, and includes some andesitic gravel lenses beneath arkose beds (Carroll and Crawford, 2000). The mapping and definition of the Dawson Formation in the Colorado Springs area, including the survey corridor, is problematic because it includes rocks which are equivalent to the late Cretaceous and early Paleocene Denver Formation elsewhere in the Denver Basin. Part of the difficulty arises from the fact that a distinctive paleosol which is used to distinguish the Paleocene and Eocene rocks elsewhere in the basin is poorly exposed and/or does not occur in the southern part of the basin. The situation is complicated by generally poor exposures and facies-related lithology changes. Furthermore, in the Denver area, the Dawson and Denver Formations are

distinguishable on the basis of lithology, while to the south this becomes more difficult. Johnson and Raynolds (1999) have proposed eliminating the names Dawson and Denver Formations entirely, and replacing them with the terms "D1" and "D2". The D1 would include late Cretaceous and Paleocene rocks, including those mapped as Denver or Dawson Formation, which lie below the Denver Basin paleosol. First recognized by Soister and Tschudy (1978), this red clay paleosol represents a basin-wide depositional hiatus. The D2 would include early Eocene arkosic strata which lie above the paleosol (Johnson and Raynolds, 1999). Ongoing work by the DMNS and the Denver Basin Project is seeking to better document the geology of the Denver/Dawson Formation package.

The Cretaceous and Paleocene part of the Denver/Dawson formation package (D1) is considered to have moderate paleontologic potential because it contains locally abundant plant fossils (Knowlton, 1930; Brown, 1943; 1962) and a less abundant but scientifically important fossil vertebrate fauna (Middleton, 1983). The Eocene part of the Denver/Dawson formation package (D2) is considered to have low paleontologic potential because it contains only rare and generally poorly preserved plant fossils. Only one vertebrate fossil, an isolated tooth of the mammal Coryphodon, is known from the D2 (unpublished DMNS record). Because it contains locally abundant plant fossils and few vertebrates, the Dawson/Denver formation is considered to have moderate paleontologic potential (Type 2 of Raup, 1987; Class 3 of PFYC).

The terrace alluvium and pediment gravel in the vicinity of the survey corridor are reported to span from the early Pleistocene to the Holocene in age (Carroll and Crawford, 2000). The terrace alluvium consists of poorly to moderately sorted, unconsolidated, matrix-supported cobble gravel in a sandy, silty, or clayey matrix. The pediment gravel consists of pebble and cobble gravel in a matrix-supported sandy, clayey material age (Carroll and Crawford, 2000; Thorson et al., 2001). Alluvial deposits in Colorado may preserve Pleistocene fossils, but they are typically uncommon and scattered, consisting of mineralized or partially mineralized fragmentary vertebrate bones, invertebrates, and plant remains. The most common Pleistocene fossils include the bones of mammoth, bison, deer, and small mammals (Cook, 1930, 1931; Emslie, 1986; Hunt, 1954; Lewis, 1970; Scott, 1963; unpublished UCM and DMNS collections data). Because fossils are uncommon in alluvial deposits, they are considered to have low paleontologic potential (Type 3 of Raup, 1987; Class 2 of PFYC).

The Eolian sand deposits are Holocene and late Pleistocene in age, and consist of silty to coarse-grained deposited by wind and preserved on surfaces downwind of main stem river valleys (Carroll and Crawford, 2000). Wind-deposited sediments of Holocene and Pleistocene age are common in eastern Colorado and elsewhere. Although fossils are generally rarely preserved in them, fossil horse and camel bones have been found in late Pleistocene loess deposits south of Littleton, Colorado (Scott, 1963). In addition, the CDOT staff paleontologist has documented a diverse fauna from Pleistocene loess in eastern Colorado which includes badger, cottontail, jackrabbit, black-tailed prairie dog, the extinct white-tailed prairie dog, Richardsons ground squirrel, pocket gopher, vole, sagebrush vole, field mouse, and possibly Bison (Steven Wallace, CDOT, written communication, 2000). Because fossils are uncommon in windblown deposits, they are considered to have low paleontologic potential (Type 3 of Raup, 1987; Class 2 of PFYC).

The colluvium within the survey corridor is reported to be Holocene and late Pleistocene in age, and consists of mostly matrix-supported gravelly sand, silty clay, and clayey silt. It is

usually coarse grained on steeper slopes and finer grained on lower slopes (Thorson et al., 2001). Because fossils are extremely rare in colluvium, it is considered to have low paleontologic potential (Type 3 of Raup, 1987; Class 2 of PFYC).

The artificial fill within the survey corridor is composed of unconsolidated earth fill and waste rock placed during highway construction. It has no paleontologic potential (Type 3 of Raup, 1987; Class 2 of PFYC).

3.0 Methodology

3.1 Resource Assessment Guidelines

The paleontologic potential of the survey corridor was evaluated using criteria proposed by Raup (1987) and the Probable Fossil Yield Classification (PFYC) developed by the U.S. Forest Service.

Rocky Mountain Paleontology has modified the PFYC to include fossil plants. This five-tier scheme is summarized below:

- **Class 1:** Igneous and metamorphic geologic units (excluding tuffs) that are not likely to contain recognizable fossil remains. Ground-disturbing activities will not require mitigation except in rare circumstances.
- **Class 2:** Sedimentary geologic units that are not likely to contain vertebrate fossils or scientifically significant invertebrate (or plant) fossils. Ground-disturbing activities are not likely to require mitigation.
- **Class 3:** Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence. Ground-disturbing activities will require sufficient mitigation to determine whether significant paleontologic resources occur in the area of a proposed action. Mitigation beyond initial findings will range from no further action necessary to full and continuous monitoring of significant localities during the action.
- **Class 4:** Class 4 geologic units are Class 5 units that have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation. Proposed ground-disturbing activities will require assessment to determine whether significant paleontologic resources occur in the area of a proposed action and whether the action will impact the resources. Mitigation beyond initial findings will range from no further mitigation necessary to full and continuous monitoring of significant localities during the action. This classification will often not be applied until after on-the-ground assessments are made.
- **Class 5:** Highly fossiliferous geologic units that regularly and predictably produce vertebrate fossils and/or scientifically significant invertebrate (or plant) fossils, and that are at high risk of natural degradation and/or human-caused adverse impacts. These areas are likely to be poached. Mitigation of ground-disturbing activities is required and may be intense. Areas of special interest and concern should be designated and intensely managed.

Raup's (1987) criteria for the evaluation of paleontologic resources are summarized below:

- **Type 1:** Formations known to produce large numbers of vertebrate fossils are considered to have high paleontologic potential.
- **Type 2:** Formations known to produce abundant numbers of invertebrate, plant, and trace fossils, and that more rarely produce vertebrate fossils, are considered to have moderate paleontologic potential.
- **Type 3:** Formations that only rarely produce fossils are considered to have low paleontologic potential.

In general, invertebrate, plant, and trace fossils occur in large numbers when they are found, are not considered as significant as relatively uncommon vertebrate fossils.

3.2 Survey Procedures

This study was conducted at the request of Centennial Archaeology, Inc., Fort Collins, and the Colorado Department of Transportation (CDOT), Denver, Colorado. Prior to the field survey, literature and museum record searches were conducted in order to 1) determine whether any known fossil localities occur within the survey corridor, 2) assess the potential for disturbance of these localities during construction, and 3) evaluate the paleontologic potential of the rock formations and/or surficial deposits within the survey corridor. The museums included in the record search included the University of Colorado Museum (UCM) and the Denver Museum of Nature and Science (DMNS).

The field surveys were conducted on August 24th, 25th, and September 28th, 2002. Each field survey consisted of an inspection of the corridor for 1) surface fossils, 2) exposures of potentially fossiliferous rocks, and 3) areas in which fossiliferous rocks or younger potentially fossiliferous surficial deposits could be exposed or otherwise impacted during construction.

4.0 Impacts of No-Action Alternative

Under the No-Action Alternative, no new areas would be disturbed. Therefore, no disturbances of subsurface paleontological resources would occur.

5.0 Direct Impacts of Proposed Action

There are no known direct impacts to paleontological resources as a result of implementation of the Proposed Action.

Construction excavation may produce new exposures of the potentially fossiliferous Pierre Shale, Denver Formation, and Dawson Arkose.

6.0 Mitigation

Based on the results of this study, the following recommendations are made to mitigate any potential impacts to paleontologic resources.

1. Once project design plans are finalized, a qualified paleontologist will examine them to estimate the scope/magnitude of any needed construction monitoring work. If final design plans indicate the likelihood of affecting outcrops of the above-identified geologic units, CDOT will require that a paleontologist monitor construction in these areas.

2. Although unlikely, it is possible that fossils could be present in Pleistocene-aged deposits within the construction corridor, and that these could be impacted during ground-disturbing activities. Because Pleistocene-aged bones may be only partially mineralized and are often superficially similar to modern bones, they can be difficult to distinguish. If any sub-surface bones or other possible fossils are found anywhere within the survey corridor during construction, the CDOT staff paleontologist will be notified immediately to assess their significance and make further recommendations.

7.0 Confidentiality and Non-Disclosure of Data

Information on the locations of paleontological sites is not available to the general public in order to assure protection of these resources. Individuals interested in information about these sites must contact the CDOT Staff Paleontologist at 303-757-9632; however, the location and certain information about the sites may not be disclosed.

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